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ACTIVITIES OF RADIO-EQUIPPED COMMON GRACKLES DURING FALL MIGRATION

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Large numbers of migrant Common Grackles (*Quiscalus quiscula*) roost each fall at Tishomingo National Wildlife Refuge, on the north end of Lake Texoma, in south-central Oklahoma (Fig. 1). There they damage windrowed peanuts left to dry in surrounding farmland (Mott et al. 1972). A radio-telemetry study was conducted in November 1971 and 1972 to obtain information on daily activities of individual Common Grackles, and thereby gain a clearer understanding of the peanut damage problem. This paper stresses the behavior of individual birds over periods of time as distinct from impressions of what general populations appear to do when merely visually observed.

STUDY AREA AND METHODS

The study area encompassed Atoka, Bryan, Johnston, and Marshall counties in Oklahoma, and Fannin and Lamar counties in Texas. Peanuts, cotton, sorghum, wheat, and oats are major crops, and pastures are scattered through this area. Hardwoods, particularly oak (*Quercus* spp.), cover stream bottoms and hilly areas.

Three blackbird roosts were present in marshes on or near the refuge. In 1971, birds used the Nida Point and Headquarters roosts (5.3 km apart), and in 1972 the Nida Point and Bee roosts (5.1 km apart, Fig. 1). The estimated roosting population of Common Grackles, Red-winged Blackbirds (*Agelaius phoeniceus*), Brown-headed Cowbirds (*Molothrus ater*), and Starlings (*Sturnus vulgaris*) varied from 15,000 to 2,300,000 birds.

Ten of the heaviest grackles were selected from birds trapped or mist-netted near their roosts. Based on plumage iridescence and size, all 10 grackles were sexed as males. Due to the color of the iris and underwing coverts, they were aged as unknowns. Each was weighed, marked with a 3.7 × 2.5 cm plastic tag attached to the U.S. Fish and Wildlife Service leg band, instrumented with a 164 MHz transmitter (Kolz and Corner 1975) attached to the middle 4 retrices, and released. Transmitters and clips weighed an average of 3.9 g, or 3.3% of an average bird's weight (119 g).

Birds were monitored from ground vehicles or a Cessna 150 airplane with portable receivers and hand-held or vehicle-mounted antennas (Bray 1974). Trackers usually sighted the flock containing a radio-equipped grackle, and sometimes the bird itself. Locations of birds were marked on topographic maps. Birds were occasionally followed throughout a day, but they were usually monitored intermittently because of equipment repair and other interferences.

The area that grackles occupied between early morning and late afternoon movements has been termed the "major diurnal activity range" (MDAR, Bray et al. 1975). The geometric center of activity was determined for each MDAR by the method of Hayne (1949). In determining the center of activity, we used only fixes that differed from the previous fix (Hayne 1949, Tester and Siniff 1965). We calculated the mean activity radius of the MDAR by the method of Dice and Clark (1953). Mean activity radii of MDARs were determined only for the days that trackers checked on instrumented birds throughout the day.

Home ranges were delineated by connecting perimeter fixes and flight routes, and this area was measured with a compensating polar planimeter. Home range in this study refers to the home range during the period of tracking.

The Nida Point roost (Fig. 1) was chosen as a reference location on the refuge from which all bird locations could be measured, since it was the area most heavily used by roosting grackles.

RESULTS AND DISCUSSION

The 10 birds were monitored for 63 bird-days (3 to 10 days per bird). On some days a bird was located only at the roost or only in the MDAR. No data pertaining to the first day and night after instrumentation of each bird are presented in this paper because birds moved shorter distances from the roost on the first day of monitoring than on subsequent days ($P < 0.01$, 2-way ANOVA with orthogonal comparisons). No bird was monitored longer than 9 days after the 1-day adjustment period. Observed movements and activities of instrumented birds did not differ from those of other grackles after the first day.

Roosts.—Seven grackles were monitored at roosts in the refuge area on 40 bird-nights. They spent 38 bird-nights in 3 marsh roosts and 2 bird-nights in wooded areas 3.5 and 6.3 km from the Nida Point roost. Three of the 7 switched marsh roosts on 10 occasions, or 2 to 4 times per bird.

The other 3 grackles migrated soon after they were instrumented, and subsequently were located on 6 bird-nights in 5 different roosts. Distances between their roosts on successive nights ranged from 9.3 to 52.8 km, and the roosts were located from 41.5 to 96.9 km from the Nida Point roost. Distance between the Nida Point roost and successive roosts did not increase each day, as one might suspect with a migrating bird. For example, 1 grackle roosted 96.9, 65.2 and 56.8 km from the Nida Point roost on successive nights.

Movements between roost and MDAR.—Instrumented grackles always left the roost with the rest of the roosting population. On 12 of 16 mornings when 2 radio-equipped birds left at different times, the first bird out had a center of activity farther from the roost than the second one. Bray et al. (1975) made similar observations of Starlings in Oregon, indicating that usually the earlier a bird leaves the roost the farther it travels to feed.

Grackles moved fairly directly toward their MDAR on 15 of the 21 mornings that we were able to follow them, but followed indirect routes the other 6 mornings, traveling many extra kilometers before reaching their

FIG. 1. Routes from the roost to the MDAR for bird 5 on 3 days, and the location of the centers of activity for bird 2. Numbers within the center of activity symbol refer to the number of days after instrumentation.

destinations. The 3 routes in Fig. 1 show the variation in the movement patterns of 1 bird between a roost and a MDAR. On 11 November this bird traveled at least 47 km before establishing a MDAR that was 17.5 km from its roost. Another bird established a MDAR 39.3 km from its roost after traveling at least 68 km. Neither weather conditions nor roost switches appeared to cause the indirect movements. Perhaps they were the result of a search for new feeding areas, as distance between the center of activity and the preceding day's center of activity averaged 16.6 km on days of indirect movements, but only 5.5 km on days of direct movements. However, birds sometimes moved directly to new areas, and sometimes after indirect movement they ended up in an area previously visited.

On 21 bird-days when departure time was obtained, grackles left their MDARs an average of 55 min before sunset (range 33–124), tending to leave MDARs earlier on completely overcast days or when the MDAR was a greater distance from the roost. These findings agree with those from previous radio-telemetry work (Bray et al. 1975).

Instrumented birds did not always follow the same route when flying to a roost from an area visited on previous days, and there was no tendency to retrace the route used that morning. They frequently bypassed 1 of the 3 major roosts, after flying close to it, and continued on to another roost. Radio-equipped birds that were close to each other during the day did not always go to the same roost that evening.

The MDAR.—The azimuths and distances of centers of activity from the Nida Point roost are shown in Table 1. The MDARs of grackles remaining in the refuge area were scattered but somewhat clustered, with most birds having more than 1 cluster (Fig. 1). The subject bird in Fig. 1 spent 5 days in the area north and west of Folsom, then moved south to spend the next 4 days in the area north and east of Platter. The change in areas was not due to food supply or roost switches, but may be related to flock behavior (see "Flocks" section). The degree of scattering did not vary greatly. A 2-way analysis of variance indicated that there was no significant difference ($P > 0.05$) among birds in the distance of the center of activity from that of the preceding day. The distance between centers of activity on successive days averaged 11.9 km.

The distance of centers of activity from the previous night's roost averaged 23.5 km for birds that remained in the refuge area (Table 1). A 2-way analysis of variance showed at least 1 significant difference ($P < 0.05$) among birds in this parameter. The maximum distance was 44.6 km.

The mean activity radius of MDARs averaged 1.9 km (SD 1.6, range 0.2–5.0 km) on 15 bird-days that birds were adequately monitored. The mean activity radius averaged 2.6 km on days of direct movement to the MDAR, but only 1.3 km on days of indirect movement, indicating a relationship between activity radius and route traveled between the roost and

TABLE 1

DAILY MOVEMENT DATA FOR COMMON GRACKLES RADIO-TRACKED IN OKLAHOMA

Bird number	Number days monitored[a]	Azimuth, Nida Point roost to center of activity (degrees)	Distance of center of activity from Nida Point roost (km)		Distance of center of activity from previous night's roost (km)		Distance of center of activity from previous day's center (km)		Home range (km^2)
		Range	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	
			Birds that roosted in the refuge area every night.						
1	6	44–162	10.5–21.4	15.0 ± 5.1	10.6–21.4	16.4 ± 4.0	0.8–28.0	12.2 ± 10.3	199
2	9	29–164	15.9–31.4	21.1 ± 5.3	15.9–31.4	22.9 ± 6.4	0.5–38.5	10.5 ± 11.4	316
3	8	141–322	11.1–28.5	23.7 ± 6.8	10.3–32.2	25.3 ± 7.7	1.0–39.6	11.6 ± 13.0	218
4	5	148–318	8.7–28.0	16.4 ± 8.0	3.7–32.5	13.4 ± 11.7	1.9–42.2	13.2 ± 16.6	158
5	6	58–171	15.8–29.9	23.7 ± 5.8	15.8–29.9	23.2 ± 5.6	4.0–43.5	17.5 ± 17.4	736
6	2	66–74	24.8–29.6	27.2 ± 3.4	23.3–24.8	24.1 ± 1.0	5.8–12.9	8.5 ± 5.0	—
7	3	123–136	35.7–44.6	39.9 ± 4.5	35.7–44.6	39.9 ± 4.5	9.0– 9.2	9.0 ± 0.2	—
All 7 birds	39	29–322	8.7–44.6	23.8 ± 8.2	3.7–44.6	23.5 ± 8.4	0.5–43.5	11.9 ± 2.9	325.4±[b] 236.5
			Birds monitored in refuge area and after they migrated.						
8	4	57–117	18.2–45.7	31.9 ± 15.4	8.7–18.8	15.3 ± 5.6	0.8–35.1	14.6 ± 14.6	
9	4	111–133	23.8–65.2	52.6 ± 19.3	7.7–32.7	21.4 ± 12.7	3.1–41.2	17.7 ± 17.1	
10	3	79–132	18.5–62.6	47.3 ± 24.9	5.1–58.1	27.2 ± 27.5	0.8–53.4	18.7 ± 30.1	
All 3 birds	11	57–133	18.2–65.2	43.9 ± 10.8	5.1–58.1	21.2 ± 6.0	0.8–53.4	17.1 ± 2.1	

[a] After the 1-day recovery period.
[b] Mean ± the standard deviation.

the MDAR. No relationships of mean activity radius to other factors were apparent. Precipitation had an effect with Starlings in Oregon (Bray et al. 1975).

Home range.—Home ranges averaged 325.4 km^2 for the 5 birds that remained in the refuge area and were monitored for 5 days or more (Table 1). The home ranges of 3 grackles are mapped in Fig. 2. Despite the relatively short length of the tracking periods, home range sizes were quite large because birds often visited new areas and were constantly changing the location of their MDARs. Home range size was increased greatly by the indirect routes that grackles often took while flying between the roost and the MDAR. By connecting the extreme outermost fixes of home ranges, we calculated a minimum area of 1990 km^2 used by the grackle population roosting at the 3 major roosts.

Flocks.—Telemetry and visual observations together showed the instability, within a day and between days, of large flocks of grackles. To illustrate, on 11 November 1971, birds 2 and 3 left the Headquarters roost 14 min apart and returned there in the evening, passing Little City (Fig. 2) 7 min apart. During the day they were in the same flock 3 times (09:00, 10:55, 15:00), but each time they separated with flocks that moved 1.1 to 2.3 km apart. Both birds were monitored for 2 more days but were never together again. While in their MDAR, instrumented birds were usually seen with more than 1000 grackles, the maximum being 70,000. Flock size was not consistent throughout the day, nor was there a discernible pattern of buildup or reduction except at staging time when flock size usually increased.

These findings are similar to those for the Red-winged Blackbird. From retraps of banded red-wings, Packard (1936) found that the makeup of flocks appeared to change continually, as individuals frequently shifted flocks. Smith and Bird (1969:44) suggested that "A blackbird flock appears to be an open community that can be added to or subtracted from readily."

Migration.—Six of the 10 birds migrated while their transmitters were operating. Five of them migrated ahead of or during cold fronts. This behavior was typical, for the grackle population at the 3 major roosts dropped drastically as each cold front moved through. We noticed no changes in the activities of the instrumented birds that would indicate they were about to migrate.

One grackle migrated when it left the Bee roost at 06:47 and flew 58.7 km southeast to near Ivanhoe, Texas. Later that day the bird moved northeast 13.7 km to near Elwood, Texas. Its center of activity was 53.4 km from

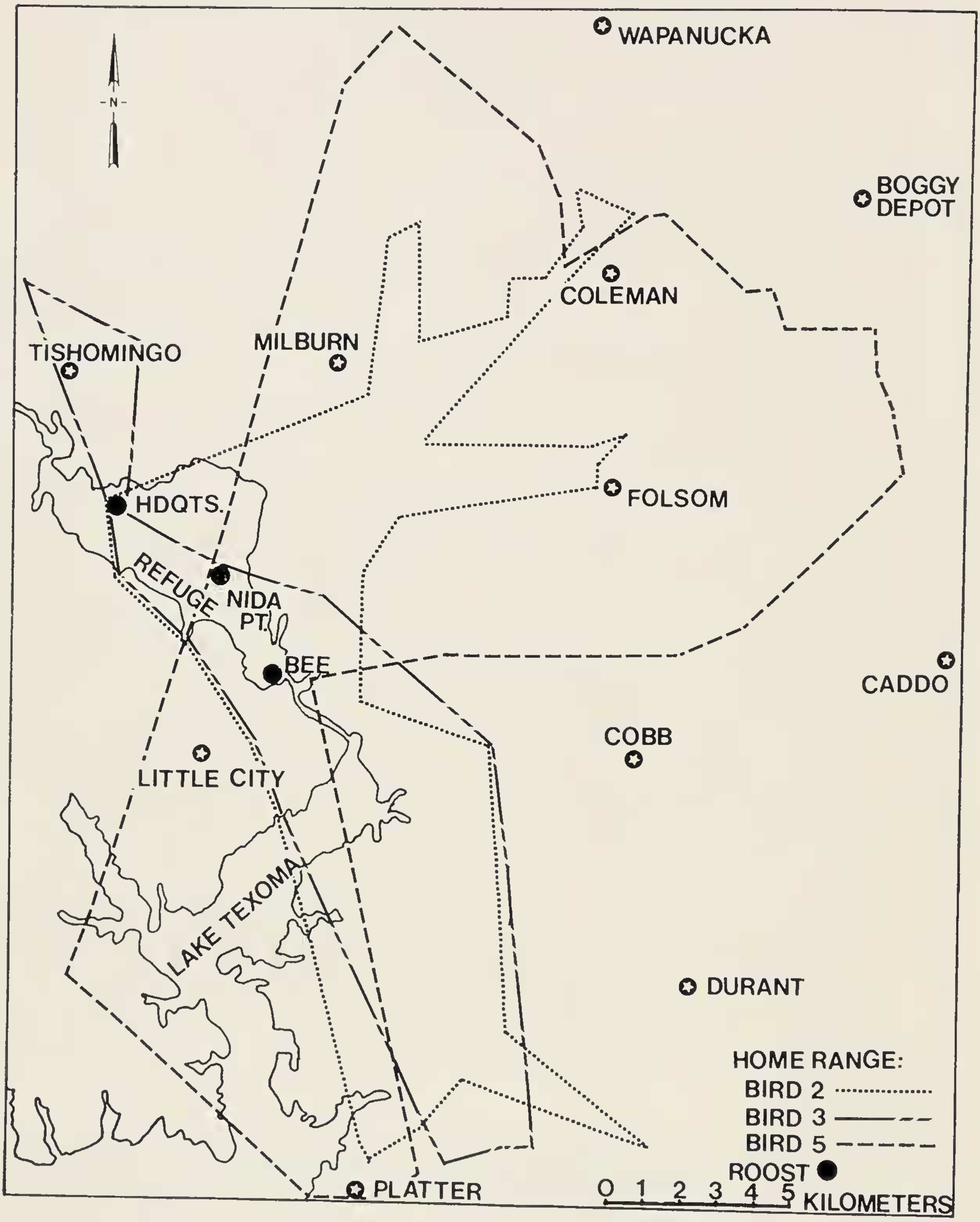

FIG. 2. Home ranges of 3 radio-equipped Common Grackles.

that of the previous day. Two other grackles evidently migrated in the morning also, but were not located after they left the refuge area.

The other 3 grackles migrated after they left their MDARs from 44 to 62 min before sunset and flew south. Two of these birds were on MDARs northeast of the refuge (near Boggy Depot and Folsom, Fig. 2) and the other was southeast of the refuge (near Cobb). We were unable to keep up with the birds, so we did not locate their roosts that evening. Two of the birds were located the next day, one near Bokchito, Oklahoma, the other near Elwood, Texas (centers of activity were 35.1 and 41.2 km, respectively, from those of the previous day).

These movements were characteristically like those of "near migrants," i.e., those having a prolonged migration wherein migration thrusts are interspersed with feeding pauses of 4–10 days (Blyumental' 1973). However, the 35–53 km movements were much shorter than the 200 km or greater distance of thrusts to which Blyumental' referred.

Management implications.—Within MDARs, 31% of 251 fixes on instrumented grackles were in oak forests, 29% in harvested peanut fields, 24% in pastures and only 6% in unharvested peanut fields. Moreover, only 3 of 58 peanut fields used by these grackles were unharvested. The heavy use of harvested fields was due to the abundance of waste peanuts in many fields (> 70%) that were harvested before or during the tracking periods, and because many farmers used bird frightening devices in unharvested fields. Peanut growers could lower bird pressure on unharvested peanut fields and other maturing crops by delaying tillage of harvested fields until all waste peanuts are eaten, or until all grackles have migrated.

There were only 2 instances when a radio-equipped grackle revisited a peanut field it had used on a previous day. We may infer that it would be easier for growers to frighten birds from unharvested fields if the birds did not become habituated to those fields. However, it also means that for any given field, continuous control efforts would be needed. A chemical fright-producing agent as referred to by Mott et al. (1972) would work most effectively if all peanut growers in an area used it, so that depredating birds would associate peanuts (rather than a particular field) with the control agent.

The lack of feeding site fidelity observed in our study was in contrast to Meanley's (1971:24) finding that some color-marked Red-winged Blackbirds returned daily to feed in the same part of a ripening ricefield in Arkansas. He indicated other blackbirds (including Common Grackles) also exhibited this behavior.

SUMMARY

Ten Common Grackles captured in the northern part of Lake Texoma, Oklahoma, were radio-equipped and monitored for 63 bird-days in November during the peanut damage season. This paper emphasizes those findings that cannot be obtained from visual observations alone.

The birds used 3 major marsh roosts on 38 of 40 bird-nights that they roosted in that area, but they switched roosts 10 times. Three grackles were located in 5 different roosts after they migrated. The distance between the 5 roosts and the previous night's roost varied from 9.3 to 52.8 km.

The distance of center of activity of the major diurnal activity range (MDAR) from the previous night's roost averaged 23.5 km for birds that remained in the refuge area. Distances between centers of activity on successive days averaged 11.9 km, but these centers tended to be clustered. The mean activity radius of MDARs averaged 1.9 km. Home ranges averaged 325.4 km^2. The minimum area used by the roosting population was calculated to be 1990 km^2.

While in their MDARs, instrumented grackles spent most of their time in oak forests, peanut fields (29% in harvested fields and 6% in unharvested), and pastures. They used 58 peanut fields (55 harvested and 3 unharvested), but individuals rarely revisited a field they had used on a previous day. The daily and day-to-day composition of large flocks of grackles was unstable.

Of 6 grackles that migrated, 5 moved out ahead of or during cold fronts. Three migrated in the morning after leaving the roost and 3 migrated from their MDAR in the late afternoon. Migration thrusts ranged from 35 to 53 km.

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